

MERGERS AND ACQUISITIONS AND PRODUCTIVITY IN THE U.S. MEAT PRODUCTS INDUSTRIES: EVIDENCE FROM THE MICRO DATA

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This article investigates the motives for mergers and acquisitions (M&As) in the U.S. meat products industry from 1977 to 1992. Results show that acquired meat and poultry plants were very productive before mergers, and that all but the very largest meat slaughter and processing plants and all but the bottom 20% of the poultry slaughter and processing plants significantly improved their productivity growth in their postmerger periods. These results lead to the conclusion that synergies and related efficiencies are important motives for M&As.

Key words: acquisitions, meat industries, mergers, productivity, structural change.

The U.S. meat products industry has undergone a dramatic business consolidation over the past two decades. The four largest firms in the meat packing industry slaughtered 36% of all steers and heifers in 1960, but, by 1997, the four largest firms slaughtered 80% of all steers and heifers (see, MacDonald et al. 2000). Over the same period, meat and poultry firms engaged in numerous mergers and acquisitions (M&As), peaking over 1977–1982. Based on data derived from the U.S. Bureau of the Census' Longitudinal Research Database (LRD), the value of acquired meat plants between 1977 and 1982 amounted to \$14.10 billion in value of shipments, that is, 30.43% of 1977 U.S. meat products industry shipments (SIC 201). This contrasts sharply with the 1972–1977 period when acquired plants accounted for only 3.84% of the industry's 1972 total value of shipments.

Changes in industry concentration and its related M&A activity have caused concern about abuses of market power. Congressional hearings held in 1985 and 1990 focused on cattle prices and rancher losses. The 1990 hearings emphasized packer concentration and

the growing control of the three major cattle slaughter firms. Subsequent to these meetings, the U.S. Congress mandated that the U.S. Department of Agriculture (1996) (USDA) study potential monopolistic pricing practices and M&As in the meat packing industry. The USDA, through contracts with several universities, examined price determination in slaughter cattle procurement, the effect of concentration on prices paid for cattle, vertical coordination in hog production, hog procurement in the Eastern corn belt, and the role of captive supplies in beef packing. The results were inconclusive but consistent with findings from other studies (see chapter 7, USDA). Although the study emphasized the need for more attention to firm behavior and practices, it also recommended an examination of entry, exit, mergers, market shares, and other market factors.

The motives for M&As are of particular concern to federal authorities due to their potential for anticompetitive behavior stemming from ever higher industry concentration. The Grain Inspection and Stockyards Administration of USDA, for example, conducted twenty-seven investigations of potentially anticompetitive behavior in the meat packing industry in 2001. These investigations addressed alleged restrictions of competition, apportionments of territory, and failures to compete. Additionally, concern about concentrated purchasing power in livestock procurement has led to class-action law suits by cattlemen alleging that Tyson and EXCELL

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used contracting methods to drive down the price of cattle on the spot market.

The purpose of this article is to examine some of the motives for M&As and how plants performed after their acquisition.¹ The article relies on detailed plant-level data to examine the relationship between M&As and the productivity performance of plants in three four-digit SIC meat product industries: meat packing (SIC 2011), sausages and other prepared meats (SIC 2013), and poultry slaughtering and processing (SIC 2015) for the period 1977–1992. The data include an unbalanced panel of 6,000 plants owned by meat products firms in 1977 and 1982 and contained in the LRD and Manufacturing Plant Ownership Change Database (OCD). The empirical results indicate that initial plant size and productivity are positively related to ownership change and M&As positively affect productivity growth in most meat and poultry plants over 1977–1987 and 1982–1992.

Our empirical model is similar to that by McGuckin and Nguyen (1995) but differs in several important ways. First, McGuckin and Nguyen (1995) examine mergers and acquisitions in the food and kindred product industry (SIC 20). The results obtained from this broadly defined industry may not apply to specific individual four-digit SIC industries. Second, McGuckin and Nguyen's (1995) study covers only merger activities occurring over 1977–1982 and evaluates the performance of acquired plants in 1987 (five to ten years after merger). In contrast, this article considers two major merger periods: 1977–1982 and 1982–1987 and evaluates the performance of acquired plants in 1987 and 1992. Third, while McGuckin and Nguyen (1995) treat ownership change as an exogenous variable, we treat it as an endogenous variable.

Mergers and Acquisitions: Motives and Consequences

The literature on M&As is long and diverse. Some economists view M&As as a method for furthering antisocial activity such as monopoly power (Mueller and Burkhard 1999; Roll 1986). Others focus on whether opportunistic

managers undertake mergers to achieve their own objectives, such as empire building (Baumol 1967; Mueller and Burkhard 1999) and management entrenchment (Shleiffer and Vishney 1989), rather than profit maximization. A third group of researchers asserts that acquisitions are undertaken because managers of acquiring firms underestimate their ability to improve the acquired firms' performance (Roll 1986). Another set of economists contends that firm efficiency is the motive for M&As, arguing that only efficient firms survive while inefficient ones are taken over (Manne 1965; Jensen 1988).

Many economists have supported the view put forth by Williamson (1964) that firms merge for efficiency reasons. Jensen (1988) emphasizes the potential for improved productivity and reduced costs from reallocation of resources within the firm, and antitrust authorities recognize the importance of efficiencies in the merger guidelines. For example, the revised section 4, Horizontal Merger Guidelines, issued by the U.S. Department of Justice and the Federal Trade Commission, April 8, 1997, states that the efficiencies generated through mergers can enhance the merged firm's ability to compete and may result in lower prices, improved quality, enhanced services, or new products.

Two "efficiency" theories often cited in recent empirical studies are "disciplinary mergers" and "synergistic" mergers. The theory of disciplinary mergers asserts that M&As discipline managers of target plants or firms who pursue objectives other than profit maximization. That is, acquiring firms take over poorly performing firms (or plants) and then improve their acquisitions' performance by replacing existing managers with superior ones. The theory of synergistic mergers postulates that acquiring firms' managers target good firms or plants. They believe that they can achieve efficiency gains by combining the good businesses or plants of the acquired firms with their own businesses or plants. For example, acquirer management may believe that it has managerial skills that can complement a first class manufacturing plant of the target. By combining operations, the target plant may achieve higher operational efficiencies due to increased capacity utilization.²

¹ Our data do not lend themselves to examining questions of monopolistic or monopsonistic intent but can be used to evaluate the production efficiency of a combined operation. For example, the surviving firm of an M&A may raise the productivity of its target, making the merger efficient.

² For more discussions of these merger theories see Lichtenberg and Siegel (1992), Matsusaka (1993), and McGuckin and Nguyen (1995).

Empirical studies offer sharply differing perspectives. Early empirical studies in the fields of industrial organization and finance found little evidence of efficiency gains from M&As.³ With the development of the LRD at the U.S. Bureau of the Census, comprehensive data have become available on the operations of U.S. manufacturing plants. Using a sample of large plants from these data, Lichtenberg and Siegel (1992) found that ownership changes negatively relate to preacquisition productivity and that acquired plants improve their productivity after mergers, leading them to conclude that lapses in the productive efficiency of firms encourages ownership changes. McGuckin and Nguyen (1995) employed the same plant-level data but without restricting plant size and only for the U.S. food and beverage industry (SIC 20) over 1977–1987. They found that ownership change is positively associated with both initial productivity and productivity growth after acquisitions. Then, after eliminating small plants from their dataset, they arrived at a result consistent with Lichtenberg and Siegel's (1992) findings that ownership change is both negatively related to initial productivity for large plants and positively associated with productivity growth. They concluded that firms acquire poorly performing large targets in order to discipline managers but purchase smaller plants for synergistic reasons.

Empirical Models

According to the theory of disciplinary mergers, acquired firms or plants should perform poorly before a merger due to poor management and then have improved performance after the plant comes under new management. For mergers motivated by synergy, acquiring firms buy high-performing targets whose resources can be combined with those of the acquirer to achieve even higher performance. Empirically, the disciplinary merger theory implies that M&As are negatively related to the target's performance before a merger while the synergy theory holds that M&As should be positively linked to premerger performance. Under both efficiency theories, M&As should positively affect the target's performance after a merger.

A Probit Model of M&As

Following previous research (e.g., McGuckin and Nguyen 1995; Lichtenberg and Siegel 1992), we specify the following probit model:

$$\begin{aligned} (1) \quad AC_{i,t+1} = & a_0 + a_1 \text{Log}(P_t) + a_2 \text{Log}(S_t) \\ & + a_3 \text{Log}(SR_t) + a_4 OM_t \\ & + a_5 NF_t + a_6 MULTI_t \\ & + a_7 \text{Log}(P_t) \cdot \text{Log}(S_t) \\ & + a_8 \text{Log}(P_t) \cdot \text{Log}(SR_t) \\ & + a_9 \text{Log}(P_t) \cdot OM_t \\ & + a_{10} \text{Log}(P_t) \cdot NF_t + u_i \end{aligned}$$

where $AC_{i,t+1}$ is a dummy variable equal to one if the plant was acquired over the time period from t to $t + 1$ and zero if not acquired. P and S equal the plant's premerger relative labor productivity (RLP) and plant size and SR indicates the primary specialization ratio (the share of plant output from products in the primary five-digit SIC of the plant). OM denotes meat plants not in the four-digit industry under investigation, for example for SIC 2011, OM equals one for plants in SICs 2013 and 2015 and zero otherwise. NF isolates plants that produce nonfood products, that is not in the food industry (SIC 20). Nonfood products include nonedible items from animal inputs, such as soap and leather, but do not cover edible products, such as tallow. Finally, we include a dummy variable for plants that are parts of multiestablishment firms ($MULTI$).

Similar to McGuckin and Nguyen (1995) and Lichtenberg and Siegel (1992) equation (1) includes P (relative productivity) and S (size) as independent variables. A positive coefficient for P indicates that the acquisition is performing well and supports the synergy hypothesis while a negative coefficient on P indicates that the plant has poor performance and supports the managerial discipline theory.

Total employment (S) represents size. Previous empirical studies have provided convincing evidence that size is an important determinant of ownership change, survival, exit, and growth. For example, McGuckin and Nguyen (1995) found that size affects the likelihood of a plant being acquired, Dunne, Roberts, and Samuelson (1989) concluded that large plants have lower failure rates than small ones, and MacDonald et al. (1999) and Ollinger, MacDonald, and Madison (2000)

³ See Jensen and Ruback (1983), Smith (1986), and Jarrell, Brickley, and Netter (1988) for finance study reviews and Mueller (1995) for industrial organization reviews.

discovered that large plants have lower average costs than small ones in animal slaughter.

MacDonald et al. (1999) and Ollinger, MacDonald, and Madison (2000) found that meat and poultry plants made dramatic changes in plant output mix over the period 1963–1992. MacDonald et al. (1999), for example, found that boxed beef shipments as a share of total output rose from 10% to 55%. To control for this increasing plant specialization, we use the specialization ratio (SR).

Census data show differences in labor productivity (LP) across industries. Thus, we include dummy variables for meat and poultry plants outside the industry under investigation and nonfood plants. Finally, since MacDonald et al. (1999) found that plants owned by multi-establishment firms had lower costs than other plants, we include a variable for these types of plants.

M&A and Productivity Growth

We examine postmerger changes in productivity with the following equation:

$$(2) \quad \Delta P = a_0 + a_1 \text{Pr}(\text{AC}_t) + a_2 O_t \\ + a_3 \text{Log}(P_t) + a_4 \text{Log}(S_t) \\ + a_5 \Delta(K/L)_t + a_6 \text{AGE} \\ + a_7 \text{MULTI}_t + a_8 \text{OM}_t \\ + a_{10} \text{NF}_t + a_{11} \Delta(\text{NW/PW})_t \\ + a_{12} \text{Log}(S_t) \cdot \text{Log}(P_t) \\ + a_{13} \text{Log}(S_t) \cdot \text{Pr}(\text{AC}_t) \\ + a_{14} \text{Log}(S_t) \cdot O_t + u_t$$

where ΔP is the change in the plant's RLP; $\text{Pr}(\text{AC})$ is an instrumental variable for the probability of a plant being acquired; $\Delta(K/L)$ is the change in the capital labor ratio; $\Delta(\text{NW/PW})$ is the change in the nonproduction (white collar) worker to production worker ratio. **AGE** is a vector of age variables in which Age1 equals one if the plant appeared in the 1972 Census of Manufacturers (CM) and zero otherwise; Age2 is one if the plant shows up for the first time in the 1977 CM and zero otherwise; Age3 equals one if the plant appears for the first time in the 1982 CM and zero otherwise. Other variables are as defined above.

In previous studies, researchers treated M&As as an exogenous variable and used OLS to estimate their regressions. However, M&As depend on the target's performance

and other characteristics, suggesting that M&As are endogenous. Thus, we use an instrumental variable defined as the fitted value of AC (ACHAT) from equation (1). That is, $\text{Pr}(\text{AC}) = q(-\text{ACHAT})$, where q is the cumulative density function for the standard normal variable. For comparison, we include the dummy variable O , which identifies whether the plant was originally owned by an acquiring firm in 1977 (for 1977–1982) or in 1982 (for 1982–1987).

Firms invest in fixed capital equipment and human resources in order to increase LP, so we use the capital/labor ratio to control for the impact of a change in plant capital intensity. Also, the change in the nonproduction (white-collar) worker to production worker ratio is used to control for the potential effect of changes in human capital, that is skill mix. Other variables are defined above.

Data and Performance Measurement

Data come from the LRD and the OCD Census files (Bureau of the Census 1972–92). The LRD has plant-data on the total value of shipments, capital investments, labor, energy, materials, and selected purchased services. It also contains information on classification and identification, such as plant location, products, and primary industry, as well as various status codes, which identify, among other things, birth, death, and ownership changes. These identifying codes are used in developing both longitudinal plant linkages and ownership relationships.⁴ The OCD identifies all U.S. manufacturing plants that were acquired at least once during the 1963–1992 period.⁵

M&As in the Meat Products Industry

Using the OCD, we, first, identified every meat and poultry plant that was acquired during the 1977–1982 and 1982–1987 periods and then determined their buyers. Next, we used the LRD to identify all manufacturing plants owned by firms that either owned or merged with at least one meat or poultry plant at the beginning of the period (1977 or 1982). For meat packing over 1977–1982, we identified forty-nine buying firms that acquired 251 plants from 101 selling firms. In 1977, the buying firms owned 684 plants and the control group,

⁴ A more complete description of the LRD is given in McGuckin and Pascoe (1988).

⁵ For a detailed description of the OCD, see Nguyen (1998).

which includes firms that did not sell or acquire plants, had 2,042 plants. Thus, our 1977 sample comprises 2,977 plants. Over 1982–1987, there were thirty-two acquiring firms that purchased 226 plants from ninety-two target firms. In 1982, the acquiring firms had 315 plants and the control group consisted of 1,326 plants, making a sample of 1,867 plants.

For prepared meat products over 1977–1982, we identified thirty buying firms that purchased 178 plants from seventy-six selling firms. In 1977, the buying firms had 412 plants of their own and the control group consisted of 1,214 plants, creating a sample of 1,804 plants. During the period 1982–1987, there were thirty-eight acquiring firms that purchased 353 plants from 120 target firms. Before their mergers in 1982, these acquirers had 580 plants. Since the control group consisted of 1,155 plants, the entire sample of prepared meat products plants for 1982 amounted to 2,088 plants.

Finally, forty-six poultry slaughter and processing firms bought 312 plants from 102 selling firms over 1977–1982. In 1977, these buying firms owned 518 plants and the control group included 442 plants, making a sample of 1,272 plants. Over 1982–1987, there were twenty-nine poultry slaughter and processing firms that acquired 316 plants from 203 target firms. In 1982, the acquirers had 560 plants and the control group comprised 359 plants, leaving a sample of 1,235 plants.

Productivity

We conduct a plant-level productivity analysis of three important industries—meat packing, prepared meat products, and poultry slaughter and processing, over the periods 1977–1987 and 1982–1992.⁶ Productivity performance is based on comparisons of productivity in 1977 with 1987 and 1982 with 1992. We focus on mergers over these two periods because they encompass four censuses of manufactures (1977, 1982, 1987, and 1992), so we are con-

fident of correctly identifying all acquired plants—information is available only for a sample of plants in noncensus years. Additionally, the period encompasses the beginning years of the latest merger movement, which extended until 1987. Finally, by using the period from 1977 to 1992, we can evaluate the performance of plants and firms five to nine years after their acquisition, providing sufficient time for acquiring firms to integrate their acquisitions into their operations or to dispose of them.

Productivity can be measured for a single input, such as labor (LP), or for all inputs (total factor productivity [TFP]). Theoretically, TFP is superior because it covers all inputs. However, we use LP because TFP requires data for capital services, material inputs, and other real inputs that are not available from the LRD. Note, the Census Bureau does have data on the historical value of plant, buildings, and equipment, but these assets have unknown input prices.

Two measurement problems arise for LP, which is defined as the value of plant output in current dollars divided by total plant work hours. First, output prices are necessary for each plant because output mix varies across plants, yet accurate price data do not exist.⁷ Second, prices change over time. To mitigate these problems, Christensen, Cummings, and Jorgenson (1981) proposed using RLP, which is defined as the ratio of (nominal) plant LP to average (nominal) industry labor productivity (ALP):

$$(3) \quad RLP_{ij} = LP_{ij} / ALP_j$$

where i and j denote plant i and four-digit SIC industry j , respectively.

Olley and Pakes (1992), Bartelsman and Dhrymes (1992), McGuckin and Nguyen (1995), and Bailey, Campbell, and Hulten (1992) have recently used RLP in productivity analyses of plant-level data from the LRD. Bailey, Campbell, and Hulten (1992) point out that RLP does not depend on an output deflator because output in all plants is measured in current year dollars, meaning that it can be used in cross-sectional and intertemporal comparisons.

⁶ McGuckin and Nguyen (1995) point out the benefits of a plant-level analysis relative to a firm-level analysis. They indicate that performance of the acquisition is easily determined because the entire plant is acquired and productivity is directly attributable to it. An acquiring firm, however, can be both a buyer and a seller since it can buy an entire firm, all of the plants of a firm in one industry, some of the plants a firm owns in one or more industries, or a single plant while at the same time selling some of its plants. Also, firm performance is the average performance of all plants, making it possible for a firm to have one plant that performs superbly and others that fare poorly.

⁷ Abbott (1989) found that seven-digit, 1982 Census of Manufacturers, product prices at the plant-level vary substantially across plants.

Table 1. Average Initial Relative Labor Productivity (RLP77): 1977–1987

Type of Plants	Meat Packing		Prepared Meat Products		Poultry Slaughter and Processing	
	Number of Plants	RLP77	Number of Plants	RLP77	Number of Plants	RLP77
Acquired plants (1977–1982)	251	1.3022	178	1.0699	312	1.0334
Kept in 1987	118	1.4804	70	1.0998	157	1.0949
Sold by 1987	56	1.0122	66	1.0351	94	0.9366
Closed by 1987	77	1.2401	42	1.0824	61	1.0247
Buying firms' plants (1977)	684	1.2899	412	1.4498	518	1.1117
Kept in 1987	210	1.3413	65	1.3513	235	1.1220
Sold before 1987	209	1.2865	168	1.1847	135	1.1819
Closed by 1987	265	1.2519	179	1.1614	148	1.0284
Nonbuying firm's plants (1977)	2,042	0.8654	1,214	0.9217	442	0.8453
Kept in 1987	610	0.8250	539	0.8986	169	0.8274
Sold before 1987	35	1.2723	29	0.9586	26	0.8314
Closed by 1987	1,397	0.8713	646	0.9351	26	0.8442
All plants	2,977	1.0000	1,804	1.0000	1,272	1.0000

Source: These averages were calculated by the authors, using data from the Longitudinal Research Database of the U.S. Bureau of the Census.

Empirical Results

Productivity and M&As

Table 1 contains the 1977 RLP of acquired plants and other plants by their status in 1987, for example, kept, sold, or closed. Similar data for 1982 are available in Nguyen and Ollinger (2006). All values are normalized to the sample mean. Notice that acquired plants had LP that was higher than the industry averages by 3–30%. Also, average 1977 RLP of all plants owned by acquiring firms varied from about 1.11 to 1.45 while for nonacquiring firms' plant productivity varied from 0.85 to 0.92. Finally, the table shows that buyers kept the most productive plants and closed or resold less productive ones while nonacquiring firms sold their most productive plants.⁸ Acquirers in the 1977–1982 period resold or closed about 50% or more of the total plants they acquired after operating them for five to ten years over 1977–1987. This rate dropped precipitously over 1982–1992.

These data suggest that acquirers purchased relatively productive plants, even if plants that were closed after mergers had higher than industry-average initial LP. However, these data can be misleading without controlling for other factors, such as plant size and

other characteristics, making regression analysis necessary.

Table 2 contains the estimates of the probit regressions for the motives for M&As during the 1977–1982 and 1982–1987 periods. Columns 1, 3, and 5 have 1977–1982 results and columns 2, 4, and 6 contain the results for 1982–1987.⁹ The table shows that initial (before merger) plant size (*S*) and RLP (*P*) have positive and significant effects on M&As.¹⁰ The significantly positive relationship between ownership changes and plant productivity supports McGuckin and Nguyen's (1995) finding that firms acquire productive plants.

The estimated coefficients for the interaction term between productivity and size ($\text{Log}(P) \cdot \text{Log}(S)$) are significantly positive in all three industries over 1977–1982 and positive and significant in prepared meat products and poultry slaughter and processing in 1982–1987. However, the coefficient for this interaction term is significant and negative in meat packing for the period 1982–1987, indicating that large, productive plants in the meat packing industry were less likely to be acquired during this period.

⁹ These results hold whether or not we include plants with less than 10 employees in the estimation.

¹⁰ As pointed out by an anonymous reviewer, it is highly unlikely that firms acquire plants with fewer than ten employees. Thus, we estimated our model with both a complete sample (all plants) and a truncated sample (plants with ten or more employees). Since our results were similar, we do not report all of the results, but they are available in Nguyen and Ollinger (2006).

⁸ Some plants that disappear are actually reclassified as nonmanufacturing plants, meaning that they still are open. In addition, as found by McGuckin and Nguyen (1995), it is likely that sales from inventory and labor reductions around the time of closing may have "inflated" labor productivity.

Table 2. Probit Regressions of Acquisitions over 1977–1982 and 1982–1987

	Meat Packing		Prepared Meat Products		Poultry Slaughter & Processing	
	1977–1982	1982–1987	1977–1982	1982–1987	1977–1982	1982–1987
Intercept	–3.952** (504.20)	–2.417** (116.10)	–4.446** (338.90)	–3.312** (293.67)	–2.307** (131.39)	–2.773** (137.63)
Log(<i>P</i>)	0.189** (5.71)	0.568** (41.68)	0.175+ (2.43)	0.288** (15.08)	0.297** (8.39)	0.788** (3.76)
Log(<i>S</i>)	0.243** (680.60)	0.227** (439.63)	0.291** (511.11)	0.273** (830.35)	0.239** (495.10)	0.268** (646.28)
Log(SR)	0.300** (66.73)	–0.040 (0.73)	0.390** (60.78)	0.181** (19.46)	0.240** (29.33)	0.110* (4.98)
OM	–0.030 (0.82)	0.845** (477.19)	0.719** (276.17)	0.521** (227.14)	0.689** (343.02)	0.614** (277.48)
NF	–0.052 (1.85)	0.812** (295.86)	0.147** (7.48)	0.501** (142.85)	0.459** (106.77)	0.335** (54.16)
MULTI	0.656** (253.00)	0.331** (43.41)	0.033 (0.04)	0.209** (22.65)	0.208** (15.78)	0.001 (0.00)
Log(<i>P</i>) • Log(<i>S</i>)	0.096** (35.20)	–0.054** (9.64)	0.045+ (3.43)	0.036* (5.14)	0.034* (3.77)	0.041* (4.98)
Log(<i>P</i>) • OM	–0.561** (119.04)	–0.310** (32.04)	0.446** (40.12)	0.392** (64.46)	–0.505** (62.35)	–0.275** (18.73)
Log(<i>P</i>) • NF	–0.993** (261.17)	–0.173** (5.79)	–1.007** (113.56)	–0.686** (93.74)	–0.737** (78.24)	–0.909** (119.44)
<i>N</i>	2,977	1,867	1,804	2,078	1,272	1,207

Plus (+), asterisk (*), and double asterisk (**) denote “significant” at the 10%, 5%, and 1% level, respectively. Estimate are based on data for the whole sample. χ^2 -values are in parentheses.

To evaluate the effect of the inclusion of small plants on these estimates, we reestimated the model with a truncated sample (excluding plants having less than 10 employees). The results (not reported here) are generally consistent with those obtained from the full sample reported above. One exception is that the coefficient for interaction term becomes negative for meat packing in both periods and prepared meat products for 1982–1987. These results suggest that the largest and most productive meat packing and prepared meat product plants may be slightly less likely to be acquired than smaller or less productive plants.¹¹

To better assess the impact of productivity and size on the probability of a plant being acquired, we use the parameter estimates reported in table 2 to calculate the probabilities of plant acquisitions. Table 3 gives estimates of the probability of ownership change of meat packing plants as function of increasing plant size (the horizontal axis from left to right) and

increasing productivity (the vertical axis from top to bottom). The numbers in the cells indicate the probability (in percentage points) of ownership change. The first number in each cell is for 1977 and the second number is for 1982. Data for prepared meat products and poultry slaughter and processing are similar and available in Nguyen and Ollinger (2006).

The probability of an acquisition changes dramatically with both average labor productivity and plant size. The probability of plant ownership change ranges from less than 1% for plants with RLP and plant size in the 10th percentile for 1977–1982 and 1982–1987 to almost 29% and 17% for plants with RLP and size in the 95th percentile during the 1977–1982 and 1982–1987 periods. For prepared meat products, the probability of ownership change ranged from less than 1% at the 10th percentile for both periods to 25% and 24% at the 95th percentile for both periods. Finally, for poultry slaughter and processing, the probability of ownership change ranged from about 1% at the 10th percentile for both periods to about 39% and 54% at the 95th percentile for the two periods.

Summarizing, our regression and probability analyses indicate that acquirers purchase

¹¹ To evaluate the robustness of our results, we also estimated two nonlinear models. In one of these models, we included a term equal to the square of the size variable and in the other model we estimated various size class dummy variables. The results did not significantly differ from those reported here.

Table 3. The Probability of Being Acquired by Plant Size and Productivity in Meat Packing

Percentile and Value of Relative Labor Productivity for 1977 and 1982	Percentile of Plant Employment Number of Plant Employees 1977 and 1982						Mean
	10	25	50	75	90	95	
	1	3	16	74	250	433	93
	2	7	24	85	296	563	123
Probability of being acquired in percentages							
10 percentile							
1977: 0.3261	0.24	0.37	0.71	1.25	1.89	2.26	1.35
1982: 0.2650	0.08	0.28	0.81	2.15	4.93	7.22	2.73
25 percentile							
1977: 0.5491	0.32	0.58	1.34	2.69	4.43	5.47	2.96
1982: 0.3794	0.17	0.49	1.25	2.93	6.11	8.57	3.68
50 percentile							
1977: 0.9478	0.44	0.91	2.47	5.48	9.50	11.90	6.09
1982: 0.6612	0.39	0.95	2.07	4.27	7.88	10.51	5.13
75 percentile							
1977: 1.1068	0.47	1.03	2.91	6.59	11.52	14.45	7.35
1982: 1.1340	0.88	1.80	3.40	6.09	10.16	12.91	7.14
90 percentile							
1977: 1.6463	0.59	1.39	4.33	10.24	18.04	22.55	11.46
1982: 1.7261	1.62	2.92	4.94	8.04	12.35	15.52	9.18
95 percentile							
1977: 2.1026	0.67	1.67	5.46	13.13	23.03	28.60	14.68
1982: 2.3042	2.29	3.84	6.12	9.43	13.84	16.59	10.61
Mean							
1977: 0.9478	0.44	0.91	2.47	5.47	9.50	11.90	6.09
1982: 0.8827	0.61	1.35	2.71	5.16	9.05	11.75	6.14

Note: Probability estimates are based on the parameter estimates of the nonlinear probit model.

more productive plants and that acquisitions become more likely as both productivity and plant size grow. Firms were willing to buy poorly performing, large meat packing plants only over 1982–1987. These results are consistent with the synergistic efficiency motive for explaining mergers but differ from results required to support the managerial discipline motive. Results are also consistent with Ravenscraft and Scherer (1987), Matsusaka (1993), and McGuckin and Nguyen (1995) but differ from Lichtenberg and Siegel's (1992) conclusion that low productivity leads to ownership change. Note Lichtenberg and Siegel (1992) did find that plants undergoing a leveraged buyout had above-average productivity three years before the buyout, so our findings do not entirely differ from their results.

Postmerger Productivity Performance

Table 4 has the productivity growth regression results for the truncated sample, that is plants with 10 or more employees.¹² Columns 1,

3, and 5 show the results for 1977–1987 and columns 2, 4, and 6 contain the estimates for 1982–1992. We are mainly interested in how acquired plants performed relative to other plants after their acquisition. The tables show that the estimated coefficient for the probability of ownership change— $\text{Pr}(\text{AC})$ —is positive and significant and the interaction of probability of ownership change and plant size— $\text{Pr}(\text{AC}) \cdot \text{Log}(S)$ —is negative and significant for meat packing and prepared meats products in 1977–1987. The signs remain the same for 1982–1992 but both terms lose their significance. The results indicate that acquired plants outperformed most nonacquired plants during the postmerger periods in these two industries. Only large nonacquired plants (i.e., plants having more than 154 employees in meat packing and more than 289 employees in prepared meat products in 1977) performed

¹² Our results are similar for both the truncated and full samples for the meat packing and prepared meat product industries but

differed for the poultry slaughter and processing industry. We report the results for the truncated sample because Ollinger, MacDonald, and Madison (2000) report that strong economies of scale eliminated most small plants from the industry. Indeed, our data indicate that poultry slaughter and processing plants with fewer than ten employees accounted for only about 10% of all of the plants.

Table 4. Productivity Growth Regressions for the Truncated Sample

Variables	Meat Packing		Prepared Meat Products		Poultry Slaughter and Processing	
	1977–1987	1982–1992	1977–1987	1982–1992	1977–1987	1982–1992
Intercept	−0.340** (3.57)	−0.517** (3.78)	−0.455** (4.48)	−0.211* (2.00)	0.446** (3.13)	0.280* (2.00)
Log (<i>P</i>)	−0.478** (4.97)	−0.241* (2.00)	−0.859** (6.68)	−0.553** (6.24)	0.165 (1.31)	−0.120 (1.08)
Log (<i>S</i>)	0.071** (2.78)	0.100** (2.87)	0.076** (2.68)	0.025 (0.89)	−0.096** (2.95)	−0.044 (1.49)
Pr(AC)	0.685** (2.33)	0.407** (0.76)	1.993** (3.22)	0.218 (0.43)	−0.855 (1.80)	−0.491 (1.10)
$\Delta(K/Q)$	−0.459** (6.34)	−0.484** (7.30)	−0.487** (6.42)	−0.514 (7.74)	−0.509** (6.64)	−0.540** (7.48)
$\Delta(NW/PW)$	−0.122** (3.88)	0.047 (1.30)	−0.093** (3.27)	0.002 (0.09)	−0.091** (2.27)	0.002 (0.10)
Age2	−0.111** (6.34)	−0.100* (1.83)	−0.013 (0.25)	−0.044 (0.98)	0.011 (0.21)	−0.069 (1.24)
Age3	—	−0.123* (1.97)	—	−0.049 (0.92)	—	−0.009 (1.46)
MULTI	0.046 (0.77)	0.094 (1.23)	0.124** (2.23)	0.089+ (1.78)	−0.047 (0.69)	0.013 (0.20)
O	0.417** (2.58)	0.088 (0.46)	−0.183 (0.65)	−0.063 (0.45)	0.176 (1.10)	−0.308* (2.01)
OM	0.091 (1.28)	0.246** (3.00)	0.013 (0.15)	0.220** (3.43)	−0.091 (1.39)	0.156** (2.72)
NF	−0.043** (9.52)	0.016 (0.16)	−0.150 (1.08)	0.017 (0.24)	−0.174* (2.01)	−0.012 (0.18)
Log(<i>P</i>) • Log(<i>S</i>)	0.040+ (1.87)	−0.030 (1.16)	0.092** (2.85)	0.023 (1.15)	−0.125** (1.31)	−0.048* (1.98)
Pr(AC) • Log(<i>S</i>)	−0.136** (2.25)	−0.111 (1.20)	−0.351** (3.09)	−0.044 (0.53)	0.235** (2.69)	0.086 (1.17)
Log(<i>S</i>) • <i>O</i>	−0.079** (2.42)	−0.024 (0.65)	−0.036 (0.68)	−0.001 (0.02)	−0.020 (0.61)	0.086** (3.00)
<i>R</i> ²	0.24	0.20	0.33	0.30	0.31	0.24
<i>N</i>	699	673	506	867	533	592

Note: Truncated sample includes only plants with ten or more employees; *t*-statistics in parentheses.

Plus (+), asterisk (*), and double asterisk (**) denote “significant” at the 10%, 5%, and 1% level, respectively.

better than acquired plants over 1977–1987.¹³ These results are consistent with McGuckin and Nguyen’s (1995) finding that, except for “large” plants (i.e., plants with more than 110 employees), acquired plants outperformed other plants.

The results for poultry slaughtering and processing tell a different story. The estimated coefficient for Pr(AC) is insignificant for both periods while the coefficient for the interaction term Pr(AC) • Log(*S*) is positive and significant for 1977–1987 and positive and

insignificant for 1982–1992. These estimates imply that only large, acquired plants (having more than thirty-eight employees) in the poultry slaughtering industry outperformed nonacquired plants over 1977–1987. For 1982–1992, M&As did not show a significant effect on productivity change. This contradicts McGuckin and Nguyen’s (1995) finding that (except for large plants) M&As had a significant, positive effect on productivity growth in the food industry during 1977–1987.

Discussion and Conclusion

This article has two main findings. First, acquired plants in all three meat and poultry industries were highly productive before their

¹³ Values were obtained by taking the derivative of equation (2) with respect to acquisitions and solving for the antilog of Log *S_t*. For example, inserting data from table 4 into the derivative of equation (2) ($a_1 = a_{14} \bullet \text{Log } S_t$) gives $0.685 = 0.136 \bullet \text{Log } S_t$ and $S_t = e^{5.04} = 154$ employees.

mergers over the 1977–1982 and 1982–1987 periods. This preference by acquiring firms for productive plants is consistent with McGuckin and Nguyen (1995) for the food and beverage industry, Baldwin (1991) for all Canadian manufacturing plants, and Lichtenberg and Siegel (1992) for U.S. manufacturing plants involved in leverage buyouts.

The second finding is similar to that of Baldwin (1991), Lichtenberg and Siegel (1992), and McGuckin and Nguyen (1995) in that most acquired plants improved their productivity growth after mergers. The types of plants experiencing growth varied within the three meat and poultry industries, however. Results for the meat packing and prepared meat products industries follow the pattern identified by McGuckin and Nguyen (1995) who found that productivity improved in all acquired plants except for the very largest. Our results show that the productivity of about 85% of the acquired plants grew faster than the productivity of nonacquired plants. Only plants in the highest 15 percentile had slower productivity growth than their nonacquired counterparts.¹⁴

Results for poultry slaughter are quite different. They show that plants in the top 80th percentile by size (more than thirty-eight employees) of acquired plants had higher productivity growth than their nonacquired counterparts. The relatively poor performance of the smaller plants may be due to strong economies of scale and rapid technological and product changes that benefited larger plants more than smaller ones. Ollinger, MacDonald, and Madison (2000) show that poultry slaughter plants increased specialization in bird species slaughter, moved away from seasonal production, and added cut-up lines directly to slaughter lines to dramatically lower their costs and were realizing increasing returns to scale throughout all size categories in 1992. The very small plants tended to produce niche products that relied more on manual operations and were less able than large plants to benefit from increased specialization. Moreover, since large, highly automated poultry plants benefited from increasing returns to scale, an acquiring firm could dramatically improve its target's productivity by increasing plant size.

MacDonald et al. (1999) on the other hand, show that meat-packing plants experienced decreasing returns to scale, suggesting that large meat packing plant acquisitions had less opportunity for productivity growth.

Overall, our results most directly support the hypothesis that synergy, rather than managerial discipline, is a central motive for M&As. That is, acquiring firms prefer to purchase productive plants and improve their productivity after the merger.

Our results are not entirely consistent with previous studies. We found that large meat packing and prepared meat products and small poultry plant acquisitions did not grow faster than their nonacquired counterparts. Lichtenberg and Siegel (1992), using data for the entire manufacturing sector, found a positive and significant relationship for a much larger range of plants and, while our results for meat packing and prepared meats are similar to McGuckin and Nguyen (1995) our findings for poultry slaughter and processing differ markedly. This inconsistency leads us to conclude that conduct and performance of an individual industry can and does differ from that of a broadly defined sector. Thus, studies at the individual industry level, such as this one, are necessary for analyses of some economic activities, such as M&As.

This analysis provides evidence that firms in the meat and poultry industries preferred to acquire highly productive plants and improve their productivity, leading to the conclusion that synergies and related efficiencies are important motives for M&As.

Our analysis of the impact of M&As on plant productivity performance is based on surviving plants. Yet, table 1 makes it clear that acquiring firms did close and resell a significant number of their acquired plants, raising the possibility that productivity gains arise in M&As because of the displacement of jobs and plant closings. If this is the case, the overall benefits of M&As are not so clear. Future work will take a close look at the impact of M&As on employment, wages, and plant closings.

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¹⁴ The size distribution of acquired plants differs markedly from that of the entire industry. For example, the mean size of acquired meat packing plants in 1977 was about ninety-three employees while published Census data indicate that the population mean size was about sixty-four employees per plant.

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